Method for controlling an air-conditioning system for a motor vehicle.

The present invention relates to a method for controlling an air-conditioning system for a motor vehicle. An air-conditioning system is understood below generally to be a system for heating and air-conditioning a vehicle, in particular the interior of a vehicle.

The object of a system for heating and air-conditioning a vehicle is to provide comfortable climatic conditions for all occupants of the vehicle, to provide the driver with an environment which is free of stress and fatigue, as well as to remove, if appropriate, particles such as, for example, pollen, dust and the like from the air which is air-conditioned, and to ensure good visibility through all the windows.

In known air-conditioning systems, the airflow rate is adjusted to a setpoint value which is predetermined by the means of controlling the air-conditioning system, by setting various blower levels or by means of infinite adjustment. At high speeds of the vehicle, the dynamic pressure which occurs increases the flow rate, which brings about a change in the climatic conditions.

The invention is based on the object of making available a means of controlling an air-conditioning system, and an air-conditioning system itself, in which air-conditioning is carried out largely independently of the speed of the vehicle, using simple means.

The object is achieved according to the invention by means of a method having the features of claim 1. Advantageous refinements form the subject matter of subclaims 2 to 11.

The method according to the invention for controlling an air-conditioning system for a motor vehicle has a means of sensing the actual value of the air mass flow rate flowing into the air-conditioning system. The actual value is sensed by means of an air mass flow rate sensor. The use of air mass flow rate sensors is known in the field of motor vehicle technology for measuring the sucked-in fresh air in the intake tract. In addition, in the method according to the invention, means for increasing and/or decreasing the airflow are actuated. The actuation of these air mass flow rate control means is carried out here in such a way that the air which is fed to the air-conditioning system is adjusted to a setpoint value. In contrast to known control methods for air-conditioning systems, in the method according to the invention the air mass flow rate which is fed to the air-conditioning system is controlled. With the method according to the invention it is possible to set a predetermined setpoint value for the supplied air mass flow rate independently of the speed of the vehicle. In the method according to the invention, the air mass flow into the air-conditioning system is composed of a recirculated airflow and an external airflow. In the recirculated airflow, air is fed to the air-conditioning system again from the passenger compartment. If it is determined, on the basis of the measured actual values, that the entire air mass flow in the air-conditioning system is excessively low, the recirculated airflow and/or external airflow are increased. In order to increase the external airflow, a fan, which can be connected into the circuit in order to increase the air mass flow, is provided in an inlet duct. In this context, the fan can be connected into the circuit in individual setting levels or in an infinitely adjustable fashion. In addition, an adjustable flap, which can be adjusted in accordance with the required

airflow rate, is preferably provided in an inlet duct for the external airflow. If the flap is closed, the entering airflow rate is reduced.

In a method according to the invention, the air mass flow to the air-conditioning system is controlled independently of the speed.

The proportion of recirculated airflow and external airflow is preferably set by means of a recirculation flap. By means of the recirculation flap it is possible to set the air mass flow in accordance with the deviation of the measured actual values from the required setpoint values.

Further sensors which sense important characteristic variables of the air mass flow rate for the air-conditioning of the vehicle are preferably provided in the air mass flow to the air-conditioning system. These characteristic variables expediently include the temperature and/or relative humidity in the air mass flow to the air-conditioning system.

It also proves advantageous to provide one or more sensors, which each respond to a specific gas or specific mixtures of gases, in the airflow to the air-conditioning system. In this way, it is possible, for example, to sense exhaust gases which enter the passenger compartment, and to reduce the proportion of external air in favor of the recirculated airflow.

The object according to the invention is also achieved by means of a device for an air-conditioning system having the features from claim 12. Advantageous further developments of the air-conditioning system form the subject matter of subclaims 13 to 15.

The object according to the invention is achieved by means of a device for an air-conditioning system which has a suction element, via which fresh air is fed to the air-conditioning system. An air mass flow rate sensor which is arranged in the suction element measures an entering airflow. The suction element passes on one or more airflows to the air-conditioning system. The data which is sensed by the air mass flow rate sensor makes it possible to determine an actual value for the air mass flow into the air-conditioning system, and to pass this value on to a control system.

In one preferred further development, the suction element has an inflow line for recirculated air and an inflow line for external air. The inflow lines can preferably be equipped with means for increasing and/or decreasing the airflow. For example, it is possible to provide in the inflow line for external air fans and/or opening flaps which can be actuated electrically and are actuated by a control device on the basis of the measured actual values.

In one preferred refinement, the suction element has a diverter flap which sets the proportions of external air and recirculated air in the suction element to the air-conditioning system. The air mass flow rate sensor in the inflow line is preferably provided downstream of the diverter flap and upstream of the air-conditioning system.

The method according to the invention will be described in more detail below with reference to an exemplary embodiment. In the figures:

figure 1 is a flowchart relating to the control of the air mass flow into the air-conditioning system, and

figure 2 shows a schematic configuration of the air-conditioning system.

For vehicles with heating and air-conditioning systems, an automatic air-conditioning system is advantageous, in particular since it is difficult for the driver of a vehicle to recognize and perform all the necessary settings for pleasant climatic conditions. This applies particularly in the case of personal transportation vehicles, where the driver himself feels the climatic conditions only in one region of the vehicle. Automatic control with program selection automatically ensures the correct internal temperature, airflow rate and air distribution. These variables are always linked to one another and cannot be freely changed. A temperature control circuit for the internal temperature forms the core of the system. The electronic control device senses the temperature selected by the vehicle occupants and adjusts the actual temperature to this value.

Figure 1 is a flowchart which shows schematically the sequence of an airflow rate control process according to the inventive method. In a first step 10, the airflow rate flowing into the air-conditioning system is sensed by means of an air mass flow rate sensor. The air mass flow rate sensor measures, for example, the overall airflow into the air-conditioning system, which overall airflow is composed of a recirculated airflow and an external airflow. However, it is also conceivable to provide an air mass flow rate sensor further upstream in the inflow duct for the external air. In this case, adjustment to the actual value of the external airflow could be carried out.

In a following step 12, the measured actual value is compared with a predefined setpoint value. The predefined setpoint value for the air mass flow in the

air-conditioning system is selected as a function of the selected program. If the result of the comparison between actual value and setpoint value in step 12 is that the air mass flow rate entering the passenger compartment needs to be adjusted, a controller which is known per se can make use of different control measures. The different control measures are illustrated by way of example one next to the other in figure 1. Depending on its construction, a corresponding controller can make use of one or more of the different measures.

Step 14 relates to the case in which a blower with a predetermined strength is connected into the circuit of the air-conditioning system in order to increase the external airflow. Step 16 relates to the case in which flaps for supplying external air are opened in order to increase the air mass flow rate entering the air-conditioning system.

Step 18 includes the adjustment of a recirculation flap with which the proportion of external air with respect to recirculated air can be set.

Step 20 relates, for example, to a recirculation blower which increases the absolute airflow rate of the recirculated airflow into the air-conditioning system.

Figure 2 shows a schematic configuration of the air supply to the air-conditioning system. As illustrated in figure 2, an outlet line 24 makes available the air mass flow rate which is provided for the passenger compartment. Depending on the configuration of the air-conditioning system 22 and its control (not illustrated), the air mass flow entering the passenger compartment has correspondingly set values both for temperature and humidity. An appropriate control means is also used to determine the value of the air mass

flow rate which is to be made available. As a result, it is now possible for the means of control to bring about, for example, predetermined setpoint values quickly by increasing the air mass flow rate.

A sensor system 28 is provided in a feed line 26 to the air-conditioning system 22. The sensor system 28 has sensors for determining the temperature and the humidity of the inflowing air mass flow rate. In addition the sensor field 28 has sensors which detect a concentration of pollutants in the airflow rate fed to the air-conditioning system. The sensor field is also provided with an air mass flow rate sensor for measuring the air mass flow to the air-conditioning system 22. The sensors used within the scope of controlling the internal combustion engine can be employed as air mass flow rate sensors. However, to control the air-conditioning system it may also be sufficient to use less precise sensors than when controlling the internal combustion engine.

The airflow which is fed to the air-conditioning system is composed of the recirculated airflow 30 and the external airflow 32. The diverter flap 34 determines the ratio of the two airflows to one another.

The control method according to the invention has the advantages that, by means of the information about the value of the inflowing air mass flow rate, the means for controlling the air-conditioning can more quickly bring about the room climate desired by the vehicle occupant. When the air mass flow rate is measured in this context, the airflow is independent of the speed of the vehicle. The combination of a plurality of applications in the sensor field 28 has cost advantages over the individual solutions. The integration into a common housing for the sensor field reduces the required installation depth. The parameters which are

determined by means of the sensor field 28 permit the recirculated air 34 to be controlled in such a way that no increased collection of gas occurs in the passenger compartment.

In one preferred refinement, the air-conditioning system is provided with a central control unit which makes available the relevant parameters for controlling climatic conditions.